EVALUATION OF ALTERNATIVE RISK-BASED CLEANUP LEVELS FOR LOW-CONTACT, INDUSTRIAL SURFACES AT THE DSC OF NEWARK ENTERPRISES, INC. FACILITY, SOUTH PLAINFIELD, NEW JERSEY

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For Submission to

USEPA Region II

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CONTENTS

TABLES

ATTACHMENTS

I. INTRODUCTION AND PURPOSE

As part of USEPA Region II's ongoing evaluation of the DSC of Newark Enterprises, Inc. facility in South Plainfield (the Facility), on March 21, 1997, USEPA's contractor, Roy F. Weston, Inc. collected a series of wipe samples from floors, workbenches, tables, equipment and appliances in various buildings at the Facility, and analyzed them for PCBs, lead and cadmium (see Attachment A for summary of analytical results for PCBs). On behalf of Foley, Hoag & Eliot and Cornell-Dubilier Electronics, Inc. (CDE), ENVIRON has reviewed the resulting analytical data, in particular the PCB concentration data. It is ENVIRON's understanding, based on a preliminary discussion with EPA personnel, that the PCB concentration data may be evaluated by USEPA Region II by comparison to the cleanup levels specified in 40 CFR 761.120, the PCB Spill Cleanup Policy ("the Spill Policy"). For surfaces in restricted access locations (i.e., industrial settings), the cleanup levels specified in the Spill Policy consist of 10 $\mu g/100\ cm^2$ for high-contact surfaces such as manned equipment or work benches, and 10 $\mu g/100\ cm^2$, or 100 $\mu g/100\ cm^2$ with encapsulation, for low-contact, indoor, nonimpervious surfaces such as concrete floors or unmanned equipment. These levels are intended to be risk-based and deemed to protect public health. In addition, 40 CFR 761.120(c) provides the Regional Administrator the flexibility to allow less stringent or alternative cleanup requirements on a site-specific basis.

The purpose of this document is for CDE, as an interested third party, to present to USEPA Region II new information contained in relevant guidance available since the time that the Spill Policy cleanup levels were promulgated in 1987, as well as current information on the feasibility to achieve the above standards and, based on this new information, to propose an alternative risk-based cleanup level for low-contact surfaces, specifically building floors at the Facility. At this time, CDE is not proposing that the cleanup level for high-contact surfaces should be changed.

This document summarizes the basis for USEPA's current low-contact surface cleanup level, describes new information that is available relevant to developing a modified cleanup level, analyzes the impact of this new information on determining the appropriate cleanup level, and presents an appropriate cleanup level for low-contact surfaces at the Facility based on this analysis. Although the analysis presented herein follows USEPA's risk assessment methodology used to develop surface cleanup levels for the Spill Policy, and more recent Agency guidance, the use of these assumptions and methods does not necessarily imply CDE's endorsement. Rather, the analysis has been presented to demonstrate that alternative cleanup levels for low contact surfaces are consistent with that framework.

II. BACKGROUND TO USEPA SPILL POLICY SURFACE CLEANUP LEVEL

In developing surface cleanup levels for the Spill Policy in 1986, USEPA evaluated the potential for exposure to PCBs released during indoor spills, in both residential and occupational settings. Without modifying the exposure scenarios or methodology used in that evaluation, the analysis presented in this document indicates that application of more recent USEPA estimates of certain exposure factors results in an acceptable surface concentration well above the Spill Policy levels for indoor and outdoor low-contact surfaces.

Specifically, the Agency's analysis of potential occupational exposure to PCBs on low contact surfaces, such as floors, walls and ceilings was based on certain assumptions (including the transfer rate from the surface to the skin and absorption through the skin), which should be revised to reflect recent USEPA and other guidance. Part of this original analysis was documented in a USEPA internal memo, which provides background information on how USEPA established a surface cleanup level of 10 μg/100 cm^2 (USEPA 1986; "the 1986 background memo"). In that memo, USEPA presented a table which showed that a PCB surface concentration of 100 μg/100 cm^2, a transfer rate for PCBs of approximately 1%, and an absorption rate of 100% was equivalent to a 10^{-6} risk level (USEPA 1986). Similarly, if the transfer rate were approximately 10% and absorption remained at 100%, a surface concentration of 10 μg/100 cm^2 would be equivalent to the same risk level. Thus, it appears that a transfer rate of approximately 10%, an absorption rate of 100%, and a risk level of approximately 10^{-6} were used as a basis for the 10 μg/100 cm^2 cleanup level adopted in the Spill Policy.

Table 1 summarizes the values used by USEPA for various parameters in arriving at the 10 μg/100 cm^2 cleanup level. At that time, USEPA used a cancer slope factor (CSF) of 4.0 (mg/kg-d)$^{-1}$, a worker body weight of 50 kilograms (110 pounds), absorption of 100% of PCBs that contact the skin, a transfer rate of approximately 10% and a target risk level of approximately 1 x 10^{-6}. These parameter values are defined as the base line conditions, or base case, for comparison to more current information, presented in the following section. For reference, Attachment B provides the equations used in calculating the base case and alternative cleanup levels.

TABLE 1
Summary of Base Line Conditions for Current Regulatory Low-Contact Surface Cleanup Level

Spill Policy Basis for 10 μg/100 cm^2	
Cancer Slope Factor (CSF)	4.0 $(mg/kg\text{-}d)^{-1}$
Body Weight	50 kg
Absorption Rate	100%
Transfer Rate	10%
Risk Level	1.3 x 10^{-6}

III. NEW INFORMATION RELEVANT TO CLEANUP LEVELS

Since 1986, new information on many of these parameters has been developed and can be factored into USEPA's original methodology to evaluate alternative surface cleanup levels. This new information includes: (1) USEPA national and regional guidance on transfer and absorption rates that are more appropriate for PCBs; (2) experience in remediating PCB contaminated surfaces; (3) an updated USEPA cancer potency factor for PCBs; and (4) USEPA policy on appropriate risk levels to consider in evaluating remedial needs. We believe that this information significantly impacts the selection of a cleanup level appropriate for a low-contact surface in an occupational setting. Each of these items and the relevant basis is discussed in the paragraphs below.

A. Transfer Rate

Although USEPA used a transfer rate of 10% for purposes of the Spill Policy, a transfer rate of 1% was also considered by USEPA in the 1986 background memo. That memo concludes by suggesting that for low contact surfaces a transfer rate of less than 1% may be appropriate (USEPA 1986). Indeed, if the transfer rate for a nonimpervious or porous surface was as high as 10%, then the mere act of walking on or touching a surface repeatedly should significantly reduce surface concentrations. For example, touching a surface ten times would reduce the surface concentration by approximately 65%. It also should be noted that for some of the surfaces sampled, e.g., air conditioning units, the frequency of contact is likely to be extremely low, so that the transfer rates from such surfaces would be correspondingly reduced.

Furthermore, USEPA Region IV has issued interim guidance (USEPA 1995) which states that a dermal absorption factor, taking into account the soil matrix effect (i.e., transfer properties) of 1% should be used for organic compounds in determining risks associated with dermal exposure to contaminated soils. This factor is equally or more applicable to PCBs on nonimpervious or porous surfaces such as concrete for two main reasons:

- The greater effective surface area of the soil matrix relative to concrete will result in a greater mass of PCBs being available for skin contact from soil than from concrete. For concrete, access is available only to those PCBs at the planar surface, whereas for soil, contact with the larger surface area of soil particles occupying the same planar area is possible. In addition, because of the nonrigid nature of the soil surface relative to concrete, there is the potential during contact for penetration below the upper layer of soil particles resulting in exposure to PCBs below the surface layer.

- Also, in terms of adsorption of PCBs within the matrix, the concrete matrix will tend to have adsorption characteristics comparable to those of a sandy soil.

This would suggest that the transfer rates for such surfaces are much less than 10% and as USEPA concluded in 1986, probably less than 1%.

B. Absorption Rate

Since 1986, additional information and guidance also has become available on absorption factors. A review of the literature suggests that, instead of 100%, the actual absorption factor for PCBs on skin ranges between approximately 0.6% and 60% depending on the receptor, the amount applied to the skin, and the medium in which the PCBs are applied. For example, in the Agency for Toxic Substances and Disease Registry's (ATSDR) Toxicological Profile for PCBs (ATSDR 1995), a series of studies are referenced where 14.6% to 56% absorption was observed when PCBs were applied to the skin of various animals in various solvent carrier solutions. The carrier solutions used in these studies included a benzene/hexane mixture, mineral oil, and trichlorobenzene. The absorption rate observed for mineral oil, which would be most comparable to a PCB-containing dielectric fluid, was approximately 20% for both Aroclor 1242 and 1254. This scenario, however, provides much greater opportunity for absorption than actually would be the case at the Facility, where contacting a solid floor surface would be more similar to contacting soil than a free phase liquid. Visual observations of the building floors during a recent site visit suggests that free phase oil is unlikely to be the medium that would be contacted routinely on the floors of the buildings.

In USEPA guidance for conducting dermal exposure assessments (USEPA 1992), a range of 0.63% to 2.1% absorption was measured in studies of 3,3',4,4'-tetrachlorobiphenyl in soil applied to human and rat skin due to uncertainties in the data, USEPA's final recommendation was that a range from 0.6 to 6% absorption should be used. Finally, we note that USEPA's IRIS data base, as of the 6/10/97 update, specifies an upper bound cancer slope factor for PCBs for dermal exposure of 2.0 $(mg/kg/day)^{-1}$ if an absorption factor has been applied and an upper bound cancer slope of 0.4 $(mg/kg/day)^{-1}$ if no absorption factor has been applied (USEPA 1997a). The inference to be drawn from the distinction is that USEPA has assumed a skin absorption rate of 20%.

C. Cancer Slope Factor (CSF)

Carcinogenic potency is measured by means of a slope factor (SF), which is the upper-bound estimate of the low-dose slope of the dose-response curve. The SF is based on a non-threshold model, which assumes that any exposure to a carcinogen, however small, elicits a carcinogenic response. Until recently, the SF for PCBs was set at 7.7 $(mg/kg\text{-}day)^{-1}$, which was adjusted from a value of 4.0 $(mg/kg/day)^{-1}$ at the time of the Spill Policy. This SF has now been replaced by a tiered, exposure-based approach that incorporates new data and new procedures for developing SFs (in accordance with recently proposed guidance presented in USEPA [1996]), and aims at accounting for differences in toxicity between the commercial Aroclor mixtures tested in bioassays, and the PCB mixtures found in the environment.[1]

USEPA currently uses an upper bound cancer slope factor of 2.0 $(mg/kg\text{-}day)^{-1}$ for PCBs for dermal exposure if an absorption factor has been applied and an upper bound cancer slope factor of 0.4 $(mg/kg/day)^{-1}$ if no absorption factor has been applied (as described in the previous section).

1 The USEPA considers the use of toxicity data from commercial mixtures to make inferences about environmental mixtures to be the principal uncertainty with respect to PCB carcinogenicity.

D. Technological Considerations

Remedial alternatives identified for concrete floor areas include encapsulation, surface washing, and physical removal. Surface washing is the preferred remedial alternative because it is easily implemented, making it the least disruptive to operations; however, surface washing may have limitations in being able to achieve the 10 $\mu g/100\ cm^2$ level. ENVIRON's experience, along with information gathered from the experience of others, suggests that surface washing techniques can not consistently achieve the 10 $\mu g/100\ cm^2$ cleanup level, even with multiple applications, although reducing surface concentrations from high levels to below 100 $\mu g/100\ cm^2$ appears feasible. Thus, achieving PCB surface concentrations below 10 $\mu g/100\ cm^2$ is difficult and the cost increases significantly as multiple attempts are made to achieve that goal.

The remaining alternatives, physical removal such as scarifying or scabbling, or encapsulation are significantly more costly than washing. Implementing these remedial alternatives can more than double remedial costs and may be three to five times the cost of washing. In addition, physical removal followed by restoration of the concrete surface or encapsulation may require long-term monitoring and maintenance, which may be difficult for an operating industrial facility. Consideration of these technological limitations further supports the need for a higher surface cleanup level.

E. Acceptable Risk Levels

The selection of an appropriate risk level both for triggering the need for clean-up and for establishing a clean-up goal once the need for clean-up has been established is widely agreed to be a matter of policy rather than of scientific analysis. Over the last several years, USEPA has clarified its position regarding risk management policy in various memoranda and guidance documents. With respect to clean-up levels once the need for clean-up is triggered, USEPA guidance establishes a range of 10^{-6} to 10^{-4} as a basis for establishing acceptable clean-up levels, with 10^{-6} as a "point of departure." In evaluating cleanup goal options within this risk range, it is typical for the risk manager to take into account site-specific factors, such as cost-effectiveness and technological feasibility as well as the characteristics of the site, including the size and nature of the population exposed, and the future land use. As indicated in Section IIID, there may be technological feasibility limitations associated with surfaces remediation techniques depending upon the mechanism for PCB contamination of the Facility surfaces.

We also note that in defining preliminary remediation goals for soils in residential areas, the concentration established in the Agency's Guidance on Remedial Actions for Superfund Sites with PCB Contamination (USEPA 1990) is equivalent to a risk level of 10^{-5}. In addition, worker exposure levels established by OSHA standards are commonly based on acceptable risk levels of 10^{-4} or higher. In fact, the OSHA permissible exposure limit (0.5 mg/m^3 as an 8-hour time-weighted average) for PCBs in workplace air is equivalent to a risk level of 7×10^{-2} using standard USEPA exposure assumptions.

Based on the above considerations, we suggest that the use of the lowest end of the acceptable risk range (10^{-6}) is inappropriate for the relatively small worker population potentially exposed to PCB-contaminated surfaces at the Facility, and that consideration should be given to the use of higher acceptable risk levels in selecting the remediation goal.

IV. ANALYSIS OF THE IMPACT OF NEW INFORMATION ON CLEANUP LEVELS

Consistent with USEPA policy, we have considered the impact of the updated transfer rates, absorption rates and cancer slope factor on cleanup levels at cancer risk levels of 10^{-6}, 10^{-5} and 10^{-4}, and at a hazard quotient levels of 1.0 using USEPA's reference dose of 2.0×10^{-5} mg/kg-d for Aroclor 1254 (USEPA 1997b). The resulting cleanup level options are summarized in Table 2 using an updated transfer rate of one percent and an updated absorption rate in the range of 6 to 20 percent. Also, since the information to support the lower transfer rate is more limited than for the absorption rate, we have also included the cleanup level corresponding to USEPA's original 10 percent transfer estimate. At an excess cancer risk level of 10^{-6}, the resulting cleanup levels range from 109 μg/100 cm^2 using a transfer rate of 10% and an absorption rate of 20% to 3,620 μg/100 cm^2 using a transfer rate of 1 percent and an absorption rate of 6 percent. These levels are increased 10-fold and 100-fold, respectively, at excess cancer risk levels of 10^{-5} and 10^{-4}.

For the reasons stated in Section IIIE, we believe that a risk level greater than 10^{-6} is appropriate for the PCB-contaminated surfaces at the Facility. A risk level of 10^{-5} for the selection of surface cleanup levels, consistent with Agency policy use of 10^{-5}, results in a cleanup level of 1,086 μg/100 cm^2 to 36,200 μg/100 cm^2, again using the upper and lower ends of the transfer and absorption rate ranges. We consider that the lower soil-based absorption rate of 6 percent more realistically represents conditions likely to be encountered on the concrete floors of the Facility based on visual observations made during a visit to the Facility. To be conservative, however, the higher oil-based absorption rate of 20 percent is used in this analysis. Similarly, to reflect the uncertainty in the transfer rate, the higher transfer rate of 10 percent is used as an additional conservative measure. This results in a cleanup level of approximately 1,085 $\mu g/100\ cm^2$, or approximately 1,000 $\mu g/100\ cm^2$, at a risk level of 10^{-5}.

TABLE 2
Summary of Cleanup Level Options*
Low-Contact Surfaces for Recommended Transfer and Absorption Rates

		Excess Cancer Risk Level at CSF of 2.0 $(mg/kg/day)^{-1}$			Non-Carcinogenic Hazard Index at RfD of $2x10^{-5}$ mg/kg/day
T	**Abs**	10^{-6}	10^{-5}	10^{-4}	1.0
1%	6%	3,620	36,200	362,000	51,700
1%	20%	1,085	10,850	108,500	15,500
10%	6%	362	3,620	36,200	5,170
10%	20%	109	1,085	10,850	1,550

* Cleanup levels are in units of $\mu g/100\ cm^2$.

In conclusion, a cleanup level of 1,000 $\mu g/100\ cm^2$ for low contact, indoor surfaces at the Facility appropriately takes into account the most current Agency policy and guidance, is protective of human health and eliminates the concern with respect to the technological feasibility of surface washing. Application of this data and analysis should also be taken into account in determining the scope of any further sampling activities at the Facility.

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ATTACHMENT A

PCB Wipe Sampling Results for Surfaces at the DSC Facility

PCB Wipe Sampling Results for Surfaces at the DSC Facility						
Location	Aroclor 1254			Aroclor 1260		
	Conc.	Flag	Detect. Limit	Conc.	Flag	Detect. Limit
Building 6						
shelf	5.0		0.8		U	0.8
table	0.4	J	0.8		U	0.8
Building 13						
floor	7.3		0.8		U	0.8
table	1.5		0.8		U	0.8
counter		U	0.8		U	0.8
Building 18						
oven	3.2		0.8		U	0.8
bench	89		0.8	82	W	0.8
floor	7.5		0.8	4.9	W	0.8
Building 14						
low contact	6.4		0.8		U	0.8
floor	1.9		0.8		U	0.8
desk		U	0.8		U	0.8
Building 11						
floor	9.2		0.8	3.9	W	0.8
Building 12						
floor	13		0.8	12	W	0.8
table		U	0.8		U	0.8
Building 5A						
floor	70		0.8	17		0.8
office	2.0		0.8		U	0.8
work area		U	0.8		U	0.8
Building 10						
computer	2.0		0.8	0.9	W	0.8
Building 9A						
floor	16	W	0.8		U	0.8

PCB Wipe Sampling Results for Surfaces at the DSC Facility						
Location	Aroclor 1254			Aroclor 1260		
	Conc.	Flag	Detect. Limit	Conc.	Flag	Detect. Limit
Building 5						
floor	210		0.8	24	W	0.8
aisle	62		0.8	5.9	W	0.8
work area	9.9		0.8	1.1	W	0.8
A/C	500		0.8	180	W	0.8
table	350		0.8	21	W	0.8
Building 2						
floor	4.6		0.8		U	0.8
Building 3						
counter		U	0.8		U	0.8
floor	6.6		0.8	4.7	W	0.8

Notes:

Location is the location within the building where the wipe sample was collected.
Conc. is the concentration given in ug/100 cm^2.
Flag is blank for detected, U for below detection limit, J for estimated, and W for weathered.
Det. Lim. is the detection limit given in ug/100 cm^2.

ATTACHMENT B

Equations Used in Evaluating Surfaces Cleanup Levels for PCBs

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Equations Used in Evaluating Surfaces Cleanup Levels for PCBs

To examine the impact of different assumptions about transfer, absorption cancer slope factor and risk level on the estimated cleanup level, ENVIRON used the following equations taken from USEPA's 1986 internal memorandum (USEPA 1986). The exposure to PCBs is calculated as:

$$Exposure = Conc \times Area \times T \times Abs \times 10^{-3} \times 10^{-2}$$

where:

- Conc = the surface concentration of PCBs in $\mu g/100\ cm^2$;
- Area = the area of contaminated surface contacted by a worker (taken from USEPA 1986 internal memorandum as 41,200 cm^2);
- T = the transfer rate;
- Abs = the absorption rate;
- 10^{-3} = factor to convert exposure from micrograms (μg) to milligrams (mg); and
- 10^{-2} = factor to convert Area from cm^2 to 100 cm^2.

The risk associated with a particular exposure is calculated as follows:

$$Risk = \frac{Exposure \times CSF}{BW \times life}$$

where:

- CSF = the cancer slope factor in $(mg/kg\text{-}d)^{-1}$;
- BW = body weight of a worker in kg; and
- life = workers lifetime, assumed to be 70 years (25,550 days).

Substituting the exposure calculation into the risk equation results in the following:

$$Risk = \frac{Conc \times Area \times T \times Abs \times CSF \times 10^{-5}}{BW \times life}$$

Rearranging, the resultant surface concentration for a set of assumptions can be calculated as follows:

$$Conc = \frac{Risk \times BW \times life \times 10^{5}}{Area \times T \times Abs \times CSF}$$

For calculating PCB cleanup levels based on non-carcinogenic toxic effects, the dose is calculated as follows:

$$Dose = \frac{Exposure}{BW \ x \ days}$$

where:

Exposure	=	calculation shown on page A-1;
BW	=	body weight (70 kg); and
Days	=	number of days of occupational exposure (9,125 days).

The Hazard Index (HI) is calculated as follows:

$$HI = \frac{Dose}{RfD}$$

where:

RfD = The reference dose for Aroclor 1254

Substituting and rearranging, the PCB surface concentration can be calculated as follows:

$$Conc = \frac{(HI)\ (RfD)\ (BW)\ (days)\ 10^5}{(area)\ (T)\ (Abs)}$$

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